Measurement in a Process Framework

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Process and Methodology Seminar

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Agenda

A process framework: CMMI

Measurement-related Process Areas

The Measurement and Analysis Process Area

Challenges for Process Maturity and Capability

"Process Improvement Improvement"

The CMMI Product Suite provides a foundation for *enterprise wide improvement* **and adds:**

- **New emphasis on products and services as well as process**

- **Emphasis on both process capability and organizational maturity**

- **Early emphasis on Measurement and Analysis**

CMMI Is Integration and Improvement

CMMI supports process integration and product improvement.

CMMI integrates multiple disciplines into one process-improvement framework that eliminates inconsistencies and reduces duplication.
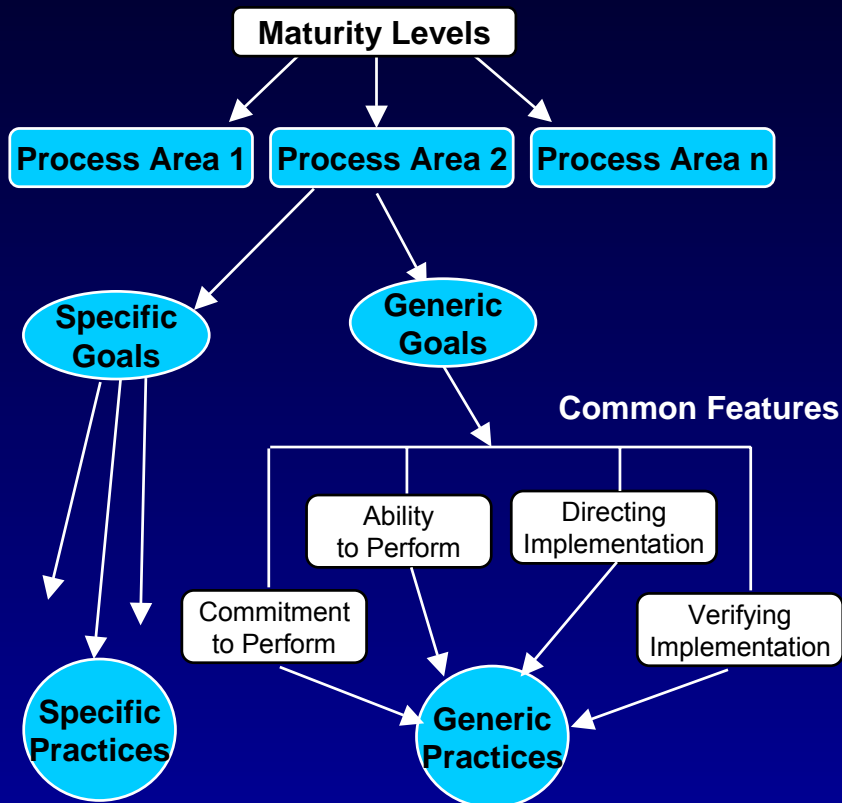
CMMI provides a framework for introducing new disciplines as needs arise and therefore reduces the cost of implementing model-based improvement.

CMMI is designed to minimize the impact on legacy process improvement efforts and investment.
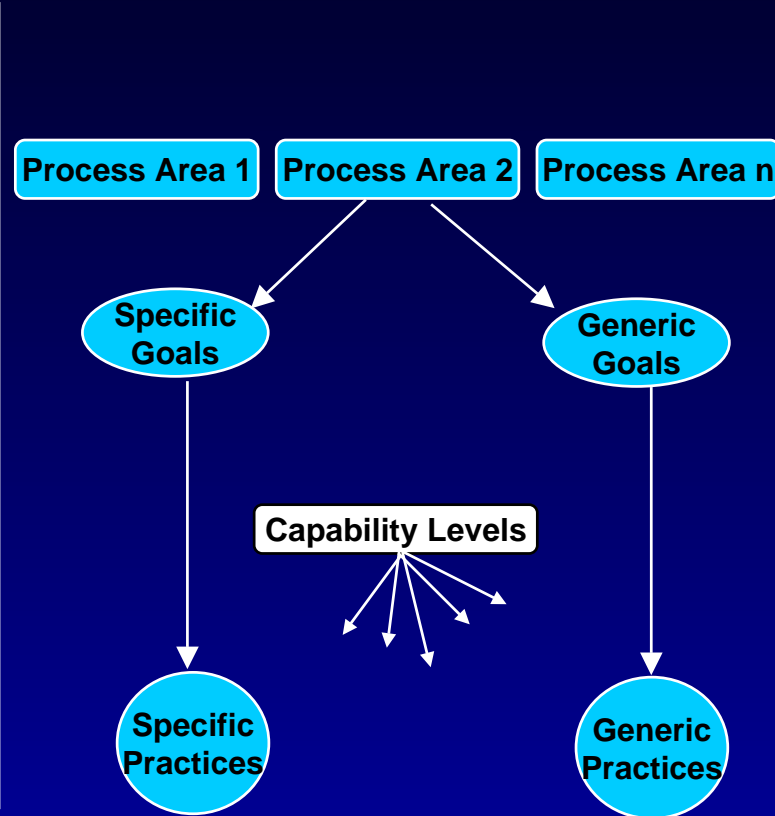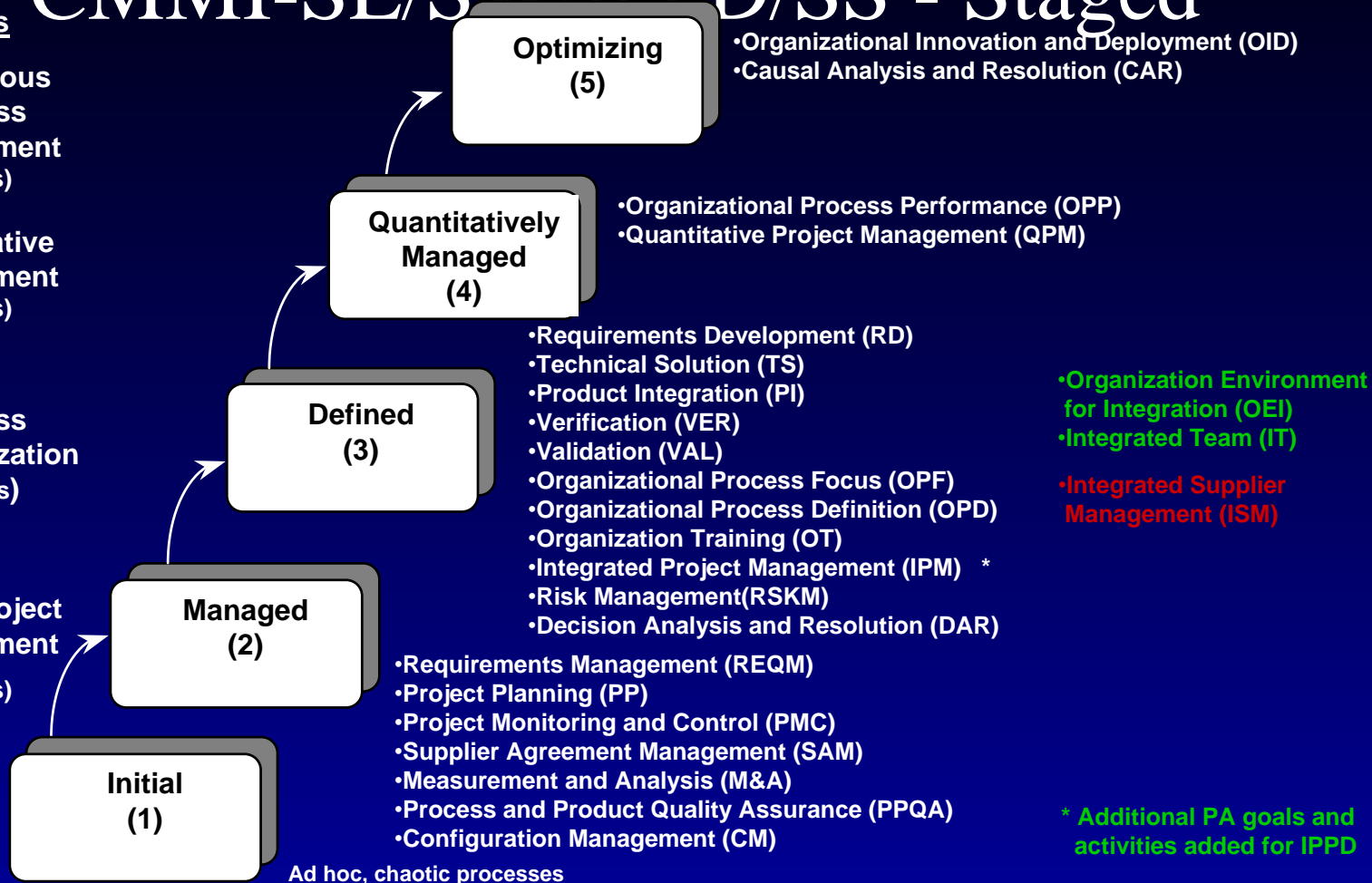
CMMI Model Structure

CMMI-SE/SW/IPPD/SS - Staged

Focus

Continuous Process Improvement (2 PAs)

Quantitative Management (2 PAs)

Process Standardization (11 PAs)

Basic Project Management (7 PAs)

Optimizing (5)
- Organizational Innovation and Deployment (OID)
- Causal Analysis and Resolution (CAR)

Quantitatively Managed (4)
- Organizational Process Performance (OPP)
- Quantitative Project Management (QPM)

Defined (3)
- Requirements Development (RD)
- Technical Solution (TS)
- Product Integration (PI)
- Verification (VER)
- Validation (VAL)
- Organizational Process Focus (OPF)
- Organizational Process Definition (OPD)
- Organization Training (OT)
- Integrated Project Management (IPM)   *
- Risk Management(RSKM)
- Decision Analysis and Resolution (DAR)

- Organization Environment for Integration (OEI)
- Integrated Team (IT)

- Integrated Supplier Management (ISM)

Managed (2)
- Requirements Management (REQM)
- Project Planning (PP)
- Project Monitoring and Control (PMC)
- Supplier Agreement Management (SAM)
- Measurement and Analysis (M&A)
- Process and Product Quality Assurance (PPQA)
- Configuration Management (CM)

Initial (1)

Ad hoc, chaotic processes

* Additional PA goals and activities added for IPPD

CMMI-SE/SW/IPPD/SS - Continuous

CMMI

Process Management	Project Management	Engineering	Support

Process Management
- Organizational Process Focus
- Organizational Process
- Definition
- Organizational Training
- Organizational Process
- Performance
- Organizational Innovation and Deployment

Project Management
- Project Planning
- Project Monitoring and Control
- Supplier Agreement Mgmt.
- Integrated Project Mgmt.
- Risk Management
- Quantitative Project Mgmt.

Engineering
- Requirements Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation

Support
- Configuration Mgmt.
- Process and Product Quality Assurance
- Measurement & Analysis
- Decision Analysis and Resolution
- Causal Analysis and Resolution

IPPD	Supplier Sourcing

IPPD
- Organizational Environment for Integration
- Integrated Team

Supplier Sourcing
- Integrated Supplier Management

Process Capability Levels

5 Optimizing

4 Quantitatively Managed

3 Defined

2 Managed

1 Performed

0 Incomplete

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Measurement-related Process Areas
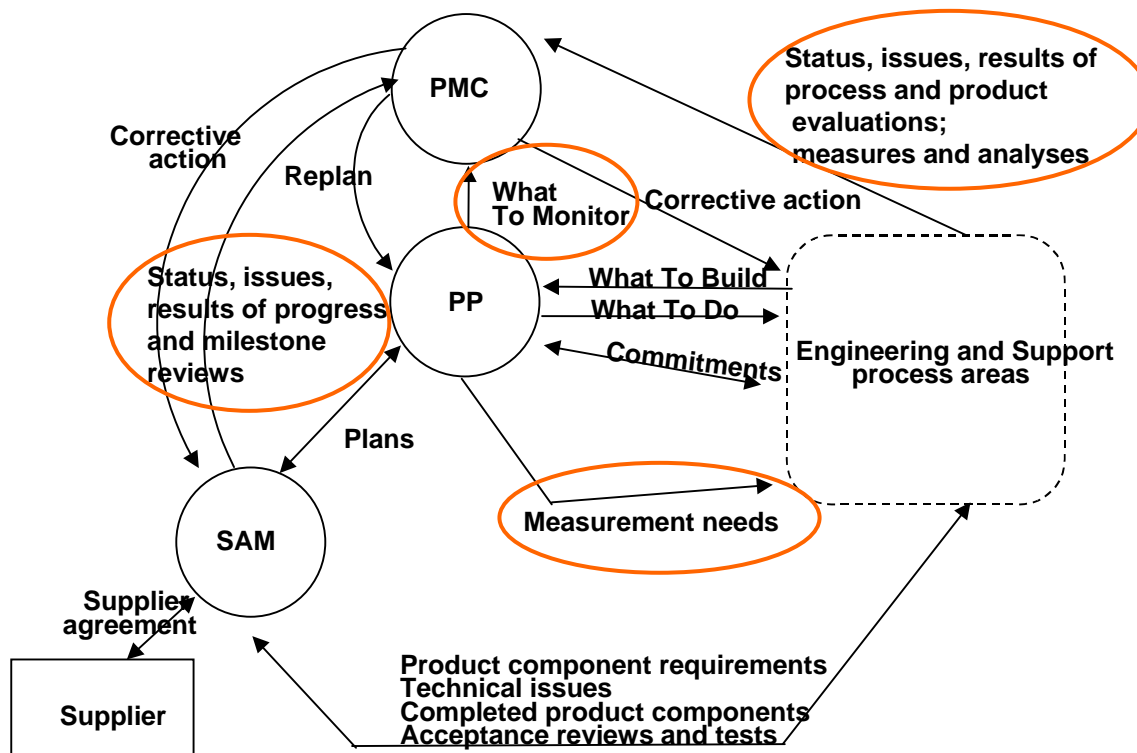
Project Management

- Project Planning, Project Monitoring and Control, Software Acquisition Management
- Integrated Project Management, Risk Management, Quantitative Project Management
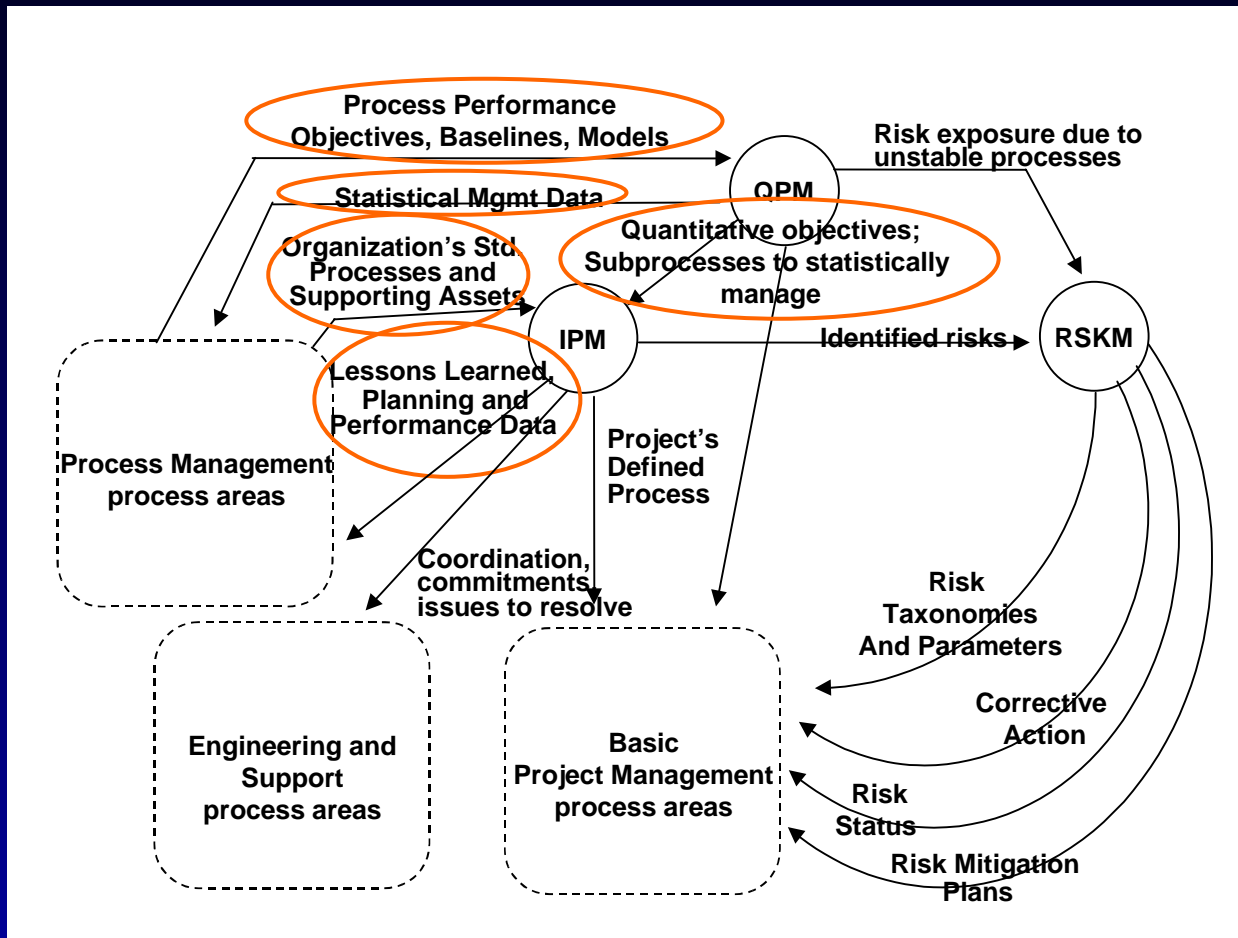
Process Management

Engineering

Basic Project Management PA's

PMC

PP

SAM

Supplier

Corrective action

Replan

What To Monitor

Corrective action

Status, issues, results of process and product evaluations; measures and analyses

What To Build

What To Do

Commitments

Engineering and Support process areas

Status, issues, results of progress and milestone reviews

Plans

Measurement needs

Supplier agreement

Product component requirements
Technical issues
Completed product components
Acceptance reviews and tests

Advanced Project Management PA's

Process Performance Objectives, Baselines, Models

Risk exposure due to unstable processes

QPM

Statistical Mgmt Data

Organization's Std Processes and Supporting Assets

Quantitative objectives; Subprocesses to statistically manage

IPM

Identified risks

RSKM

Lessons Learned, Planning and Performance Data

Process Management process areas

Project's Defined Process

Coordination, commitments issues to resolve

Risk Taxonomies And Parameters

Corrective Action

Engineering and Support process areas

Basic Project Management process areas
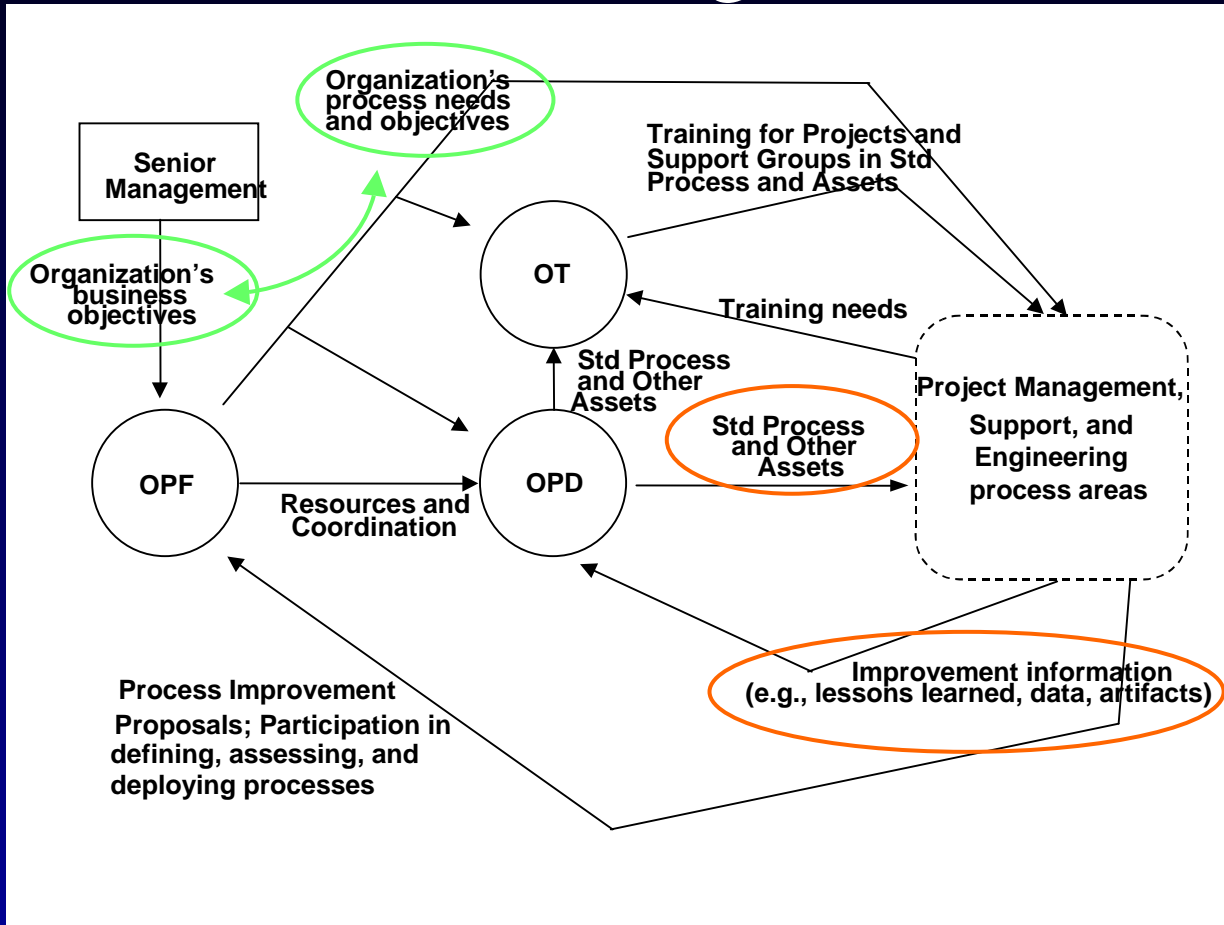
Risk Status

Risk Mitigation Plans

Measurement-related Process Areas

Process Management

- Organization Process Focus, Organization Process Definition Organization Training

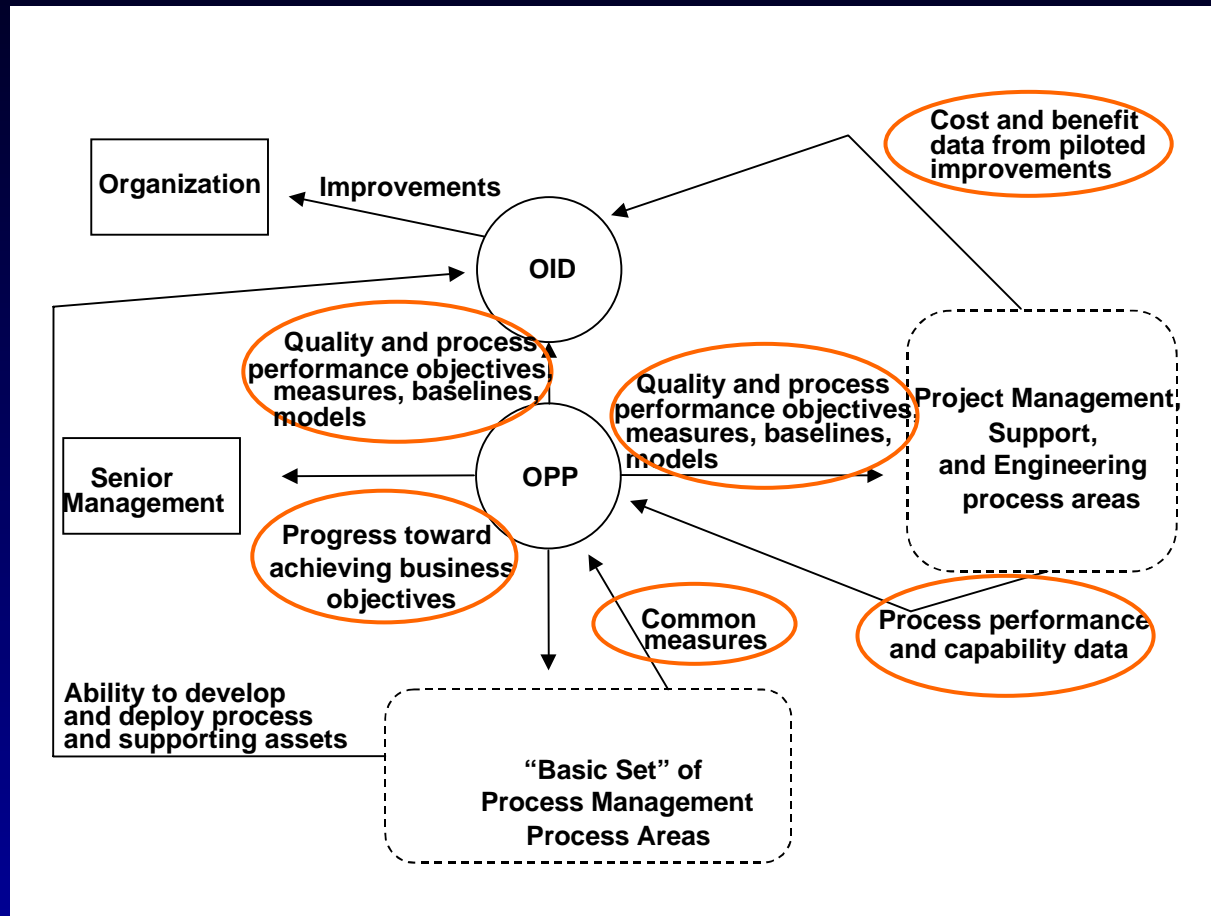- Organization Process Performance, Organization Innovation and Deployment
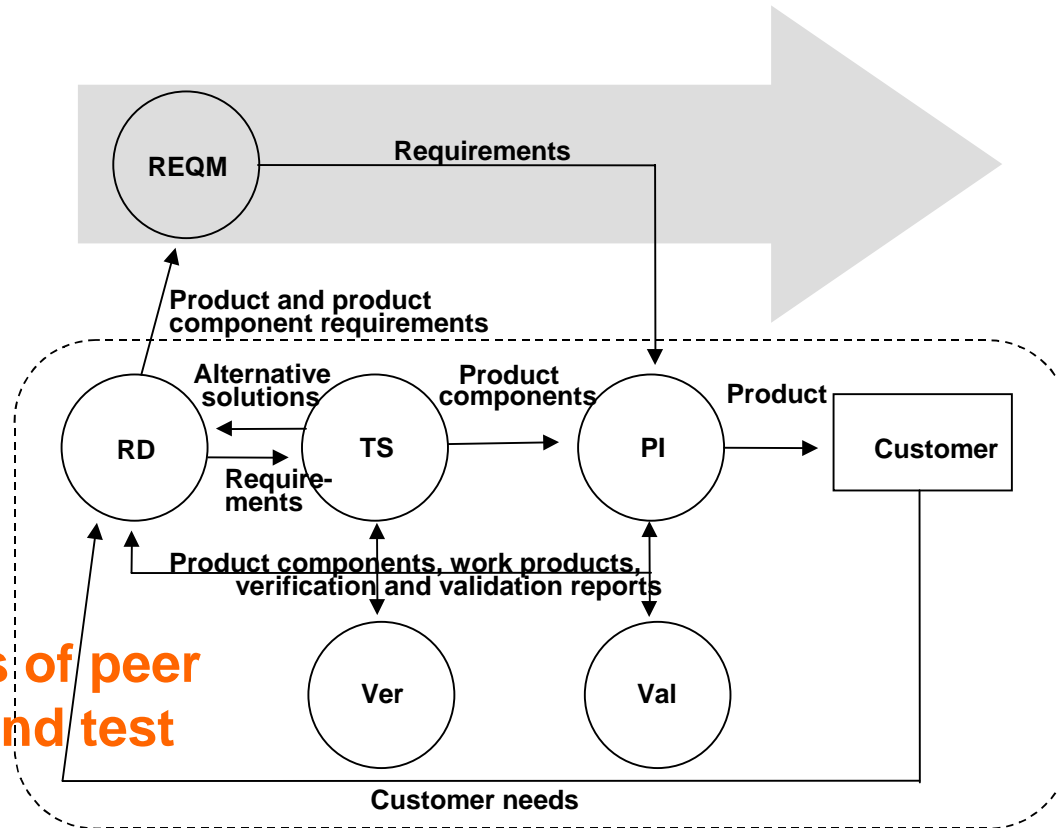
Basic Process Management PA's

Organization's process needs and objectives

Senior Management

Organization's business objectives

Training for Projects and Support Groups in Std Process and Assets

OT

Training needs

Std Process and Other Assets

OPF

Resources and Coordination

OPD

Std Process and Other Assets

Project Management, Support, and Engineering process areas

Process Improvement Proposals; Participation in defining, assessing, and deploying processes

Improvement information (e.g., lessons learned, data, artifacts)

Advanced Process Management PA's

Engineering Process Areas

SW-CMM v1.1 Common Features	CMMI Common Features
Commitment to Perform	**Commitment to Perform**
Establish an Organizational Policy	Establish an Organizational Policy
Ability to Perform	**Ability to Perform**
	Plan the Process
Provide Resources	Provide Resources
Assign Responsibility	Assign Responsibility
Train People	Train People
Activities Performed	*(Specific Practices)*
Plan the Process	
Perform the Process	
Monitor and Control the Process	
	Directing Implementation
	Identify & Involve Rel. Stakeholders
	Manage Configurations
	Monitor and Control the Process
	Collect Improvement Information
Measurement & Analysis	**Expanded in the Measurement and Analysis PA**
Measure the Process	
Analyze the Measurements	
Verifying Implementation	**Verifying Implementation**
Review with Org. Management	Review Status w/ Higher-Level Mgt
Review with Project Management	
Objectively Verify Adherence	Objectively Evaluate Adherence

Measurement-Related GPs

"Monitor and control the process against the plan and take appropriate corrective action." (GP2.8)

"Collect work products, measures, measurement results, and improvement information derived from planning and performing the process to support the future use and improvement of the organization's processes and process assets." (GP3.2)

The Measurement Thread

Two uses of measurement: project management and process improvement

As the organization matures, the sophistication and uses of measurement increase
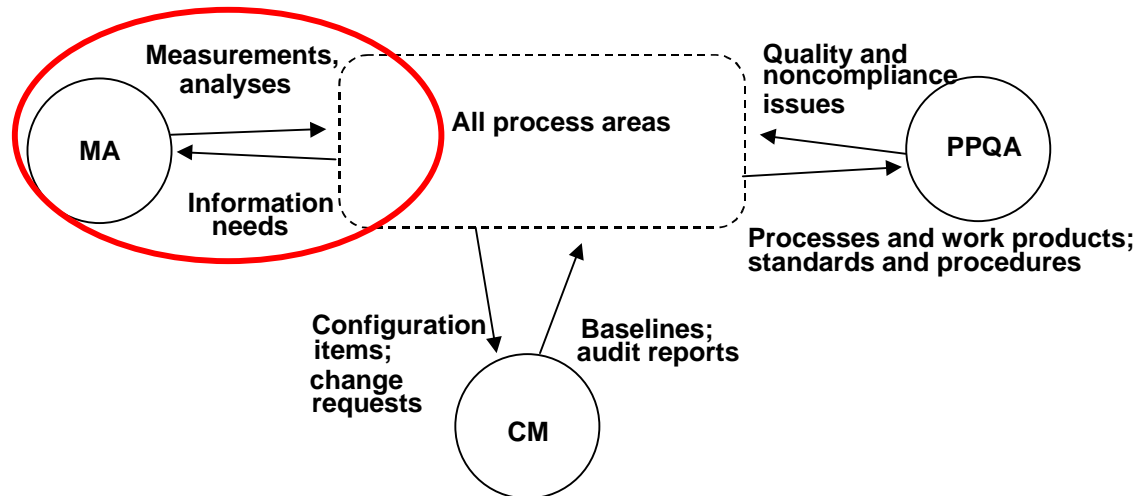
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A process framework: CMMI

Measurement-related Process Areas

The Measurement and Analysis Process Area

Challenges for Process Maturity and Capability

Support Process Areas

Measurements, analyses

MA

Information needs

All process areas

Quality and noncompliance issues

PPQA

Processes and work products; standards and procedures

Configuration items; change requests

Baselines; audit reports

CM

Measurement and Analysis - Purpose

"The purpose of Measurement and Analysis is to develop and sustain a measurement capability that is used to support management information needs."

"The Measurement and Analysis process area supports all process areas by providing practices that guide projects and organizations in aligning measurement needs and objectives with a measurement approach that will provide objective results that can be used in making informed decisions, and taking appropriate corrective actions."

Measurement the in CMM®-SW

"…practices that are necessary to determine status related to the process. Measurements included in this common feature are used to control and improve the process."

Measurement practices found in Activities Performed as well.

Measurement and Analysis Objectives

The integration of measurement and analysis activities into project processes supports the following:

- Objective planning and estimating

- Tracking actual performance against established plans and objectives

- Identifying and resolving process-related issues

- Providing a basis for incorporating measurement into additional processes in the future
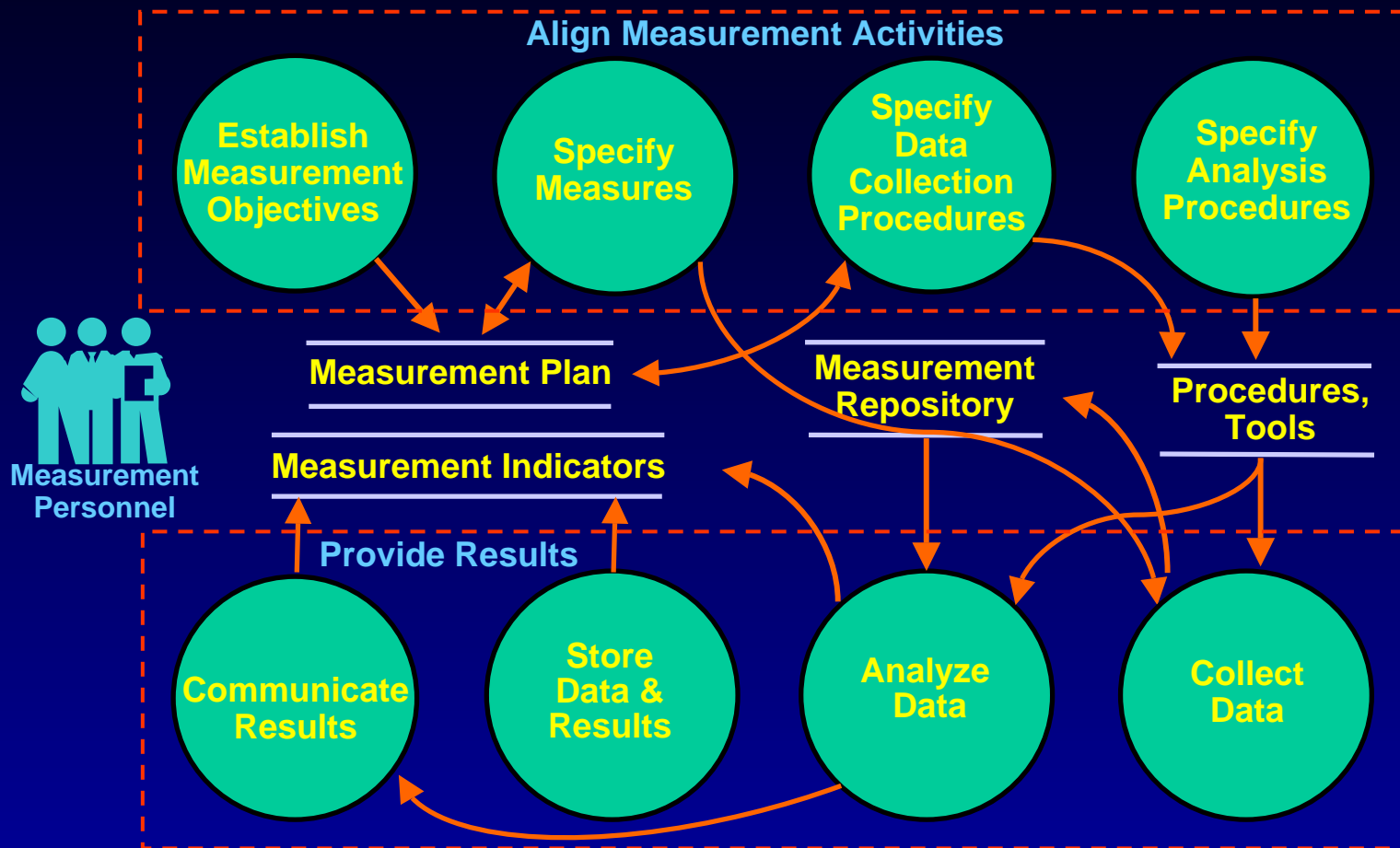
Measurement and Analysis Goals

Align Measurement and Analysis Activities

Provide Measurement Results

Institutionalize a Managed Process

The Level 2 Process Area

Activities for Goal 3

Institutionalize a Managed Process

Establish an Organizational Policy

Plan the Process

Provide Resources

Assign Responsibility

Train People

Manage Configurations

Identify and Involve Relevant Stakeholders

Monitor and Control the Process

Objectively Evaluate Adherence

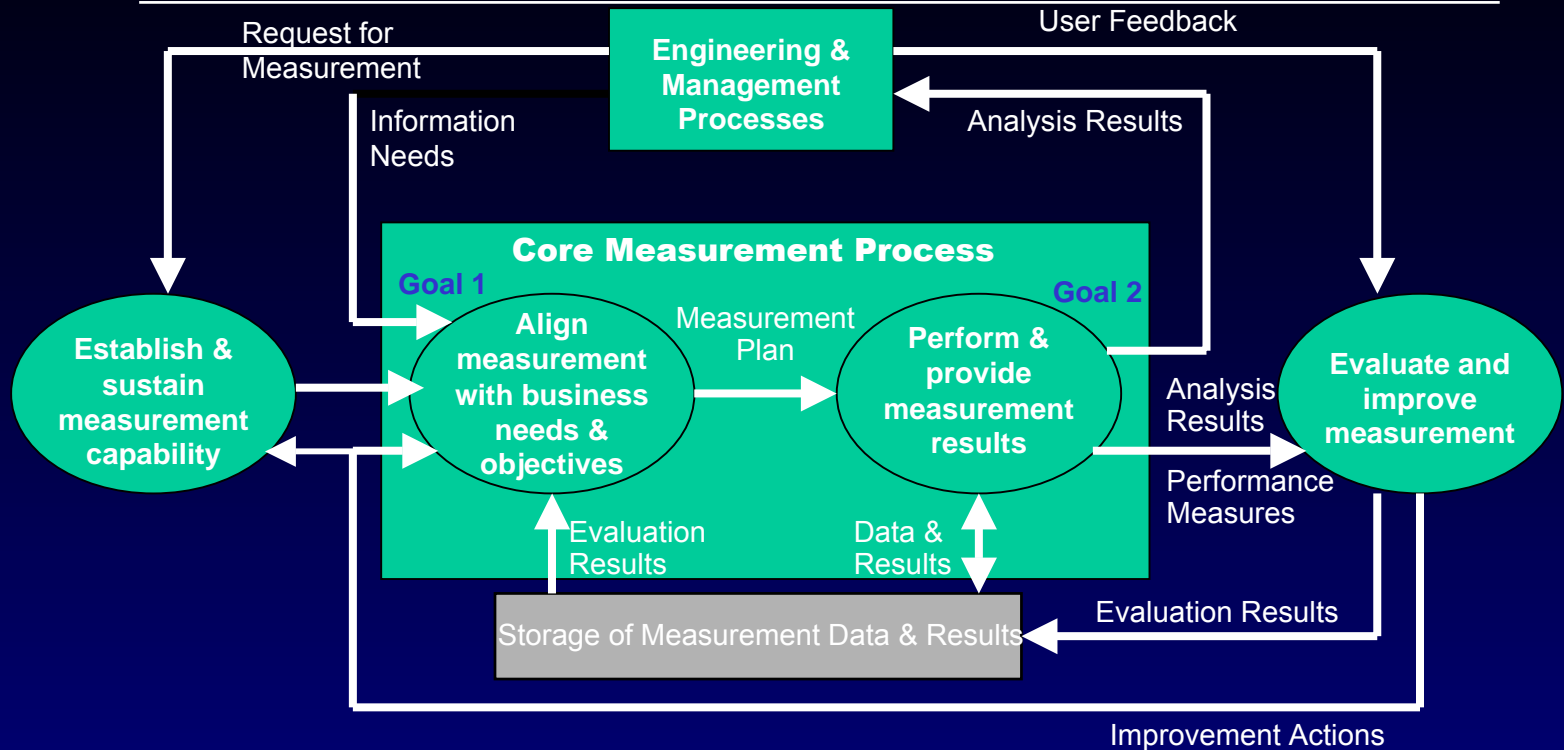**Review Status with Higher-Level Management**

ISO 15939- Software Measurement Process

Defines a process applicable to all software-related engineering and management disciplines.

The process is flexible, tailorable, and adaptable to the needs of different users.

Core Measurement Process

Request for Measurement

Information Needs

User Feedback

Engineering & Management Processes

Analysis Results

Goal 1

Goal 2

Establish & sustain measurement capability

Align measurement with business needs & objectives

Measurement Plan

Perform & provide measurement results

Analysis Results

Performance Measures

Evaluate and improve measurement

Evaluation Results

Data & Results

Storage of Measurement Data & Results

Evaluation Results

Improvement Actions

Align with Needs & Objectives

SP 1.1 Establish measurement objectives

SP 1.2 Specify measures

SP 1.3 Specify data collection & storage procedures

SP 1.4 Specify analysis procedures

Perform & Provide Results

SP 2.1 Collect measurement data

SP 2.2 Analyze measurement data

SP 2.3 Store data & results

SP 2.4 Communicate results

M&A Specific Goals:

1. Measurement objectives and practices are aligned with identified information needs and objectives
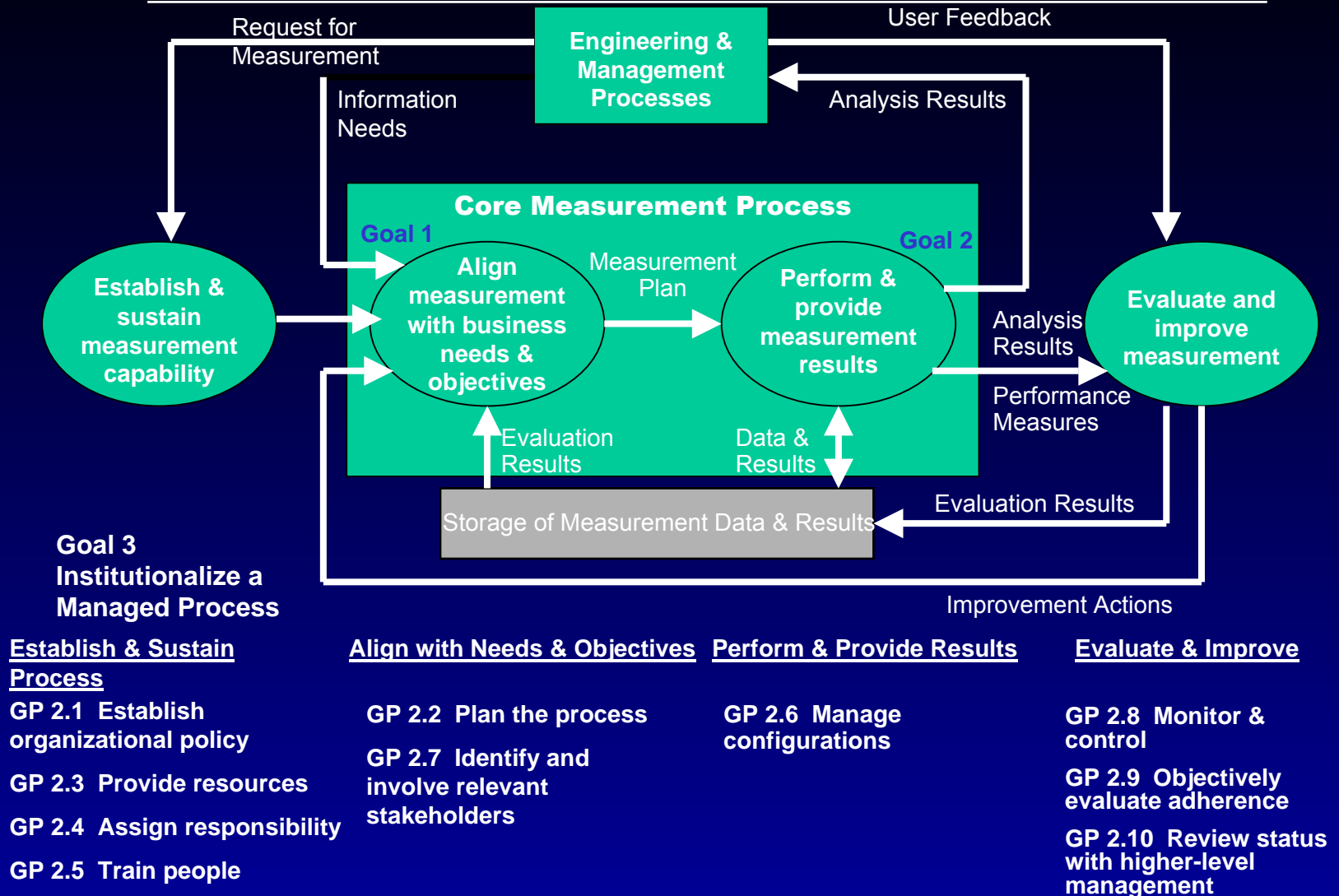
2. Measurement results that address identified information needs and objectives are provided

Adapted from presentation by Joe Jarzombek

Core Measurement Process

Request for Measurement

User Feedback

Engineering & Management Processes

Information Needs

Analysis Results

Goal 1

Align measurement with business needs & objectives

Measurement Plan

Goal 2

Perform & provide measurement results

Establish & sustain measurement capability

Evaluate and improve measurement

Analysis Results

Performance Measures

Evaluation Results

Data & Results

Storage of Measurement Data & Results

Evaluation Results

Improvement Actions

Goal 3 Institutionalize a Managed Process

Establish & Sustain Process

GP 2.1 Establish organizational policy

GP 2.3 Provide resources

GP 2.4 Assign responsibility

GP 2.5 Train people

Align with Needs & Objectives

GP 2.2 Plan the process

GP 2.7 Identify and involve relevant stakeholders

Perform & Provide Results

GP 2.6 Manage configurations

Evaluate & Improve

GP 2.8 Monitor & control

GP 2.9 Objectively evaluate adherence

GP 2.10 Review status with higher-level management

Agenda

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The Measurement and Analysis Process
Area

**Challenges for Process Maturity and
Capability**

CMMI-SE/SW v1.1 Compared to CMM-SW v1.1

Organizations using SW-CMM v1.1 should be able to transition to CMMI by focusing on the following changes:

- **Measurement and Analysis at L2**

- **Risk Management & Decision Analysis and Resolution at L3**

- **Expansion of Software Product Engineering**

- **Refocus of Measurement and Analysis CF to Directing Implementation CF**

Most SW-CMM v2 Draft C updates have been incorporated.

Challenges for SW-CMM Organizations

Consistent measurement process or approach

Integration of measurement into processes

Institutionalization of Measurement and Analysis

Consistent Measurement Process

Practices describe a process for measurement

- No consistent guidance for how to do this in CMM-SW

- Guidance addresses both measurement as associated with 'activities performed' and other common features

Explicit References to Use of Measurement

"Calls" to measurement from other process areas

Requires integration into the process for data generation and information use

Plan for measurement as part of process definition

Institutionalized Measurement Process

As a process area, Measurement and Analysis must be institutionalized

Includes evaluating how well it is working

May be difficult given how it touches all other process areas

What you can do…………NOW

Review and document your existing measurement and analysis activities and procedures
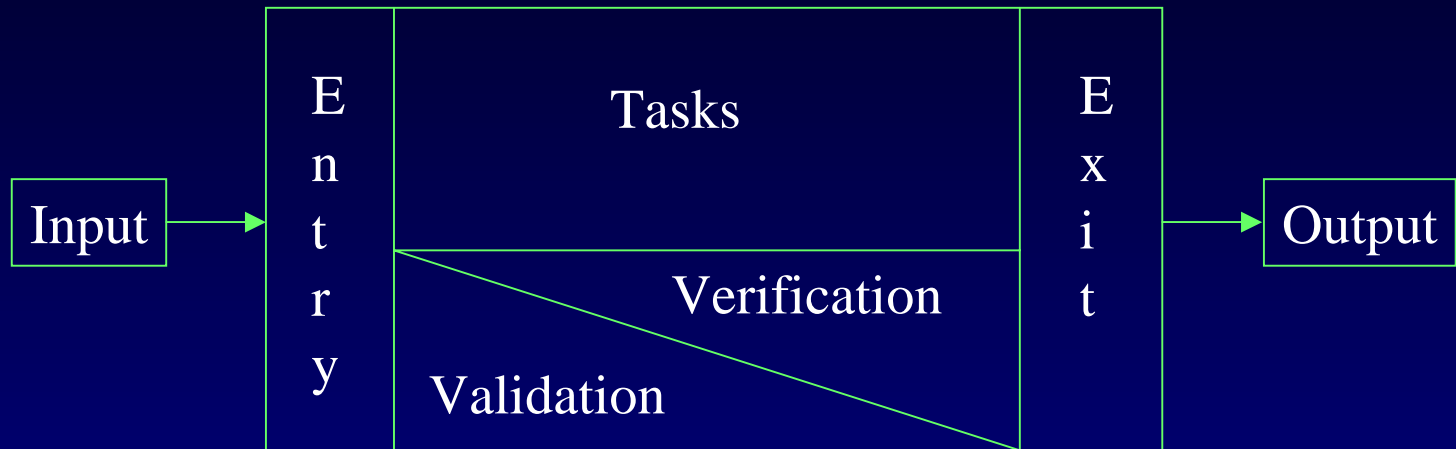
Evaluate the value of your existing measurement and analysis activities

Integrate Measurement and Analysis into your processes and train it

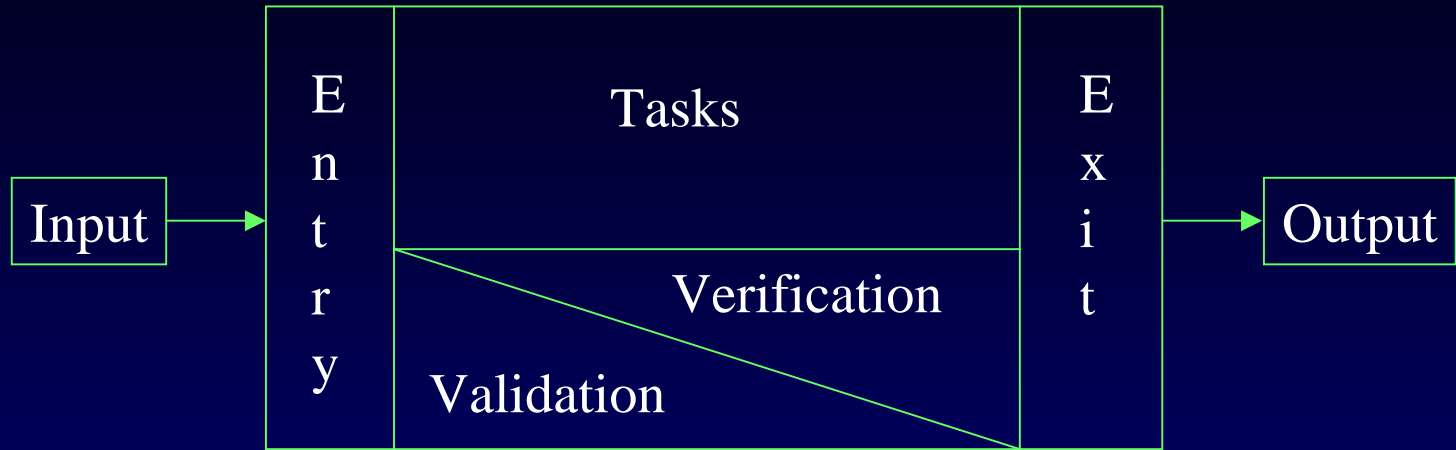Establish an organizational infrastructure to support measurement and analysis

Integrating Measurement and Analysis into Processes

Where are the data generated and how?
Who needs to use the information and when?

ETVX Derived Measures

```
                      Tasks
   ┌──────┬────────────────────────┬──────┐
   │  E   │                        │  E   │
   │  n   │                        │  x   │
Input ──▶ │ t    │        Verification    │  i   │ ──▶ Output
   │  r   │                        │  t   │
   │  y   │  Validation            │      │
   └──────┴────────────────────────┴──────┘
```

Cycle time
• Time to perform tasks
• Time from assessing entry criteria to meeting exit criteria

Efficiency
• Output/(Input+Tasks+V&V)
Effectiveness
• 1-(#outputs fail exit/total outputs)
Input Quality
• Input meeting entry/Total Input

Goal-Driven Software Measurement

Step 1: Identify your business goals

Step 2: Identify what you want to know or learn

Step 3: Identify your subgoals

Step 4: Identify the entities and attributes

Step 5: Formalize your measurement goals

Step 6: Identify your measurement questions & indicators

Step 7: Identify the data elements

Data Elements
Size
Defects

Avail	Source
+	QA
0	CM
-	?
0	Etc.
+	•
- -	•

Step 8: Define and document measures and indicators

Indicator Template
Objective ——————
Question ——————

Inputs ——————
Algorithm ——————
Assumptions ——————

Step 9: Identify the actions needed to implement your measures

Planning Tasks	Data Elements				
	1	2	3	4	5
Task 1		50	N		Y
Task 2		Y		Y	Y
Task 3	Y	Y			
Task n		N		Y	

Step 10: Prepare a plan

Verification and action plans

Mapping of M&A Practices to Indicator Template

Store Data & Results

Communicate Results

INDICATOR TEMPLATE

Measurement Goal #_____:

Objective _____

Questions _____

Visual Display

100
80
60
40
20
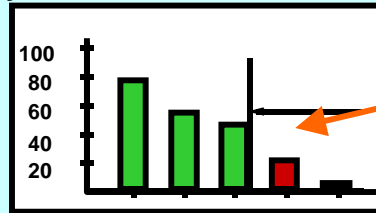
Input(s)

Data Elements _____

Responsibility for Reporting _____

Form(s) _____

Algorithm _____

Assumptions _____

Interpretation _____

X-reference _____

Probing Questions _____

Evolution _____

Establish Measurement Objectives

Specify Measures

Specify Data Collection Procedures

Collect Data

Specify Analysis Procedures

Analyze Data

In the End…………

Much better preparation at lower levels of maturity for achieving the higher levels

For More Information

Go to the SEI Website

- http://www.sei.cmu.edu/sema

- http://www.sei.cmu.edu/cmmi

Contact SEI Customer Relations

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